Claims

43. (Currently Amended) At least one of an imaging and raster-mode scanning apparatus comprising
a sample holder for holding ~~said~~ a sample object,
~~a beam generator for generating an electron beam~~,
one means selected from the group comprising
means for generating an electron beam,
means for generating a light beam, and
means for determining a force onto said sample object
actuator means for moving one of said electron beam, light beam or force determining means relative to a said sample object so as to form a scanner,
~~an image acquirer for acquiring pixels of an~~ means for forming an image when the position of one of said electron beam, light beam or force determining means is moved relatively to said sample object and optionally ~~of~~ to a predetermined reference object so as to produce image signals,
an image processor for processing said image signals,
an image display device,
an electrical filter having a signal input and a calibration input,
at least one sensor that provides a first signal dependent on ambient influence~~,~~
that might interfere with proper imaging and lead to image degradation,
said electrical filter having a settable transfer characteristic that can be set by applying a second signal to said calibration input of said electrical filter so as to calibrate said apparatus, wherein said ambient influences detected by said sensor are compensated ~~such that image degradations acquired by the image acquirer are greatly reduced or essentially compensated~~, to a certain extent, and
wherein said first signal dependent on the ambient influences passes through said electrical filter and is combined with driving signals for said actuator means of the apparatus to compensate ~~the~~ said ambient influences that ~~have an adverse effect on~~ might interfere with proper imaging.

44. (Previously Presented) The apparatus according to claim 43, wherein the at least one sensor is adapted to detect at least one physical quantity outside the apparatus, and to output the first signal that depends on the ambient influences at the location of the at least one sensor.

45. (Previously Presented) The apparatus according to claim 44, wherein the at least one sensor comprises at least one pick-up for electromagnetic fields, air vibrations and ground vibrations.

46. (Previously Presented) The apparatus according to claim 43, wherein said signal input of the electrical filter is connected to an output of said image processor.

47. (Previously Presented) The apparatus according to claim 43, further comprising a calibrator that mutually calibrates the filter.

48. (Previously Presented) The apparatus according to claim 43, said electrical filter is a digital filter.

49. (Previously Presented) The apparatus according to claim 43, wherein an output of the image processor is connected to said calibration input of the electrical filter.

50. (Currently Amended) The apparatus according to claim 43, wherein the second signal varies as a function of ~~at least one of~~ said relative position of said electron or light beam to said object. ~~and of time controlled by the scanner.~~

51. (Currently Amended) The apparatus according to claim 43, wherein the apparatus operates in a calibration mode and subsequently operates in an image mode, whereby, in the calibration mode,
~~ambient influences that degrade the image are detected by comparison of the image of the reference object under ambient influences with prestored undistorted image of the reference object in the image processor, and~~
~~wherein the comparison results in a difference representing an image defect being assigned to the~~
a first image signal of said reference object is provided in said image processor,
a second image signal of said reference object is provided under ambient influences,
then the first image signal and the second image signal are compared in the image processor resulting in an error signal which is said second signal for calibrating said electrical filter by setting said transfer characteristic thereof, and
~~whereby~~ wherein by calibration of the electrical filter, ambient influences that degrade the image signals are ~~greatly reduced or essentially~~ compensated to a certain extent. ~~for, and whereby the image defects are compensated for by maintaining the calibration in the image mode~~

52. (Currently Amended) The apparatus according to claim 51, wherein in the calibration mode:
said ~~prestored undistorted~~ first image signal of the reference object ~~ing~~ being present in said image processors, ~~as a prestored undistorted reference image signal~~, the apparatus scans, under ambient influences, a selected section of the reference object so as to obtain ~~a distorted~~ said second reference image signal,
the image processor compares said ~~prestored undistorted~~ first reference image signal with said ~~distorted~~ second reference image signal, so as to form said error signal from any difference resulting from said comparison, and
wherein the apparatus stores, in a memory, data for generating the second signal for setting the

transfer characteristics of the electrical filter for the image mode.

53. (Previously Presented) The apparatus according to claim 52, wherein in the image mode:
the apparatus scans the sample object to be imaged, and
taking said data stored during the calibration mode as a basis, generates the second signal for defining the transfer characteristics of the electrical filter.

54. (Previously Presented) The apparatus according to claim 44, wherein the apparatus is set up for automatically calibrating the electrical filter during an image mode.

55. (Currently amended) The apparatus according to claim 54, wherein said ~~acquirer~~ image forming means is adapted to scan said sample object to form successive image lines which define line centroids, or image centroids, and said image processor is set up for determining a temporal displacement of said line centroids of successive image lines across the image and outputs to the electrical filter, the second signal as a function of this temporal displacement.

56. (Currently Amended) The apparatus according to claim 55, wherein the image processor is set up for determining a temporal displacement of said image centroids of successive images scanned by the image ~~acquirer~~ forming means and outputs the second signal as a function of this temporal displacement, as determined, to the electrical filter.

57. (Previously Presented) The apparatus according to claim 54, wherein the electrical filter is set up for carrying out a cross-correlation of the first signal and of the second signal.

58. (Previously Presented) The apparatus according to claim 43, wherein the apparatus is set up for reducing or compensating for the image degradation in two mutually orthogonal directions.

59. (Previously Presented) The apparatus according to claim 43, wherein the apparatus comprises one of a scanning electron microscope, a force microscope, a surface roughness measuring instrument, an optical scanning microscope, a light microscope, a transmission electron microscope or a lithography installation.

60. (Previously Presented) The apparatus according to claim 59, wherein in the case of the electron microscope, said actuator means comprises at least one of a deflector for deflecting an electron beam and a displacer that displaces said sample object.

61. (Currently Amended) The apparatus according to claim 59, wherein in the case of the ~~light~~ optical scanning microscope, said actuator means comprises a deflector device for deflecting said light beam or a displacer that displaces said sample object.

62. (Currently Amended) ~~At least one of a~~ A light microscope ~~or a transmission electron microscope~~, comprising
a sample holder for holding a sample object,
a camera system for ~~displaying a~~ forming an image of said sample object,
actuator means for moving said camera system relative to said sample object,
~~an image acquirer for acquiring pixels~~ means for converting said image of said sample object and optionally of a predetermined reference object~~,~~
~~so as to produce~~ into image signals,
an image processor for processing said image signals,
an image display device,
a digital electrical filter having a signal input and a calibration input,
wherein said image processor, based on analysis of successive image signals, provides a first signal ~~dependent on ambient influences that might interfere with proper imaging,~~ to be supplied to said signal input of said digital electrical filter,
wherein said image ~~acquirer~~ converting means and said image processor cooperate to provide a second signal ~~dependent on ambient influences~~ to be supplied to said calibration input of said digital electrical filter,
said electrical filter having a settable transfer characteristic that can be set by applying said second signal to said calibration input of the electrical filter to effect the apparatus into a calibrated state,
wherein said ambient influences are compensated ~~such that image degradations acquired by the image acquirer are greatly reduced or essentially compensated~~ to a certain extent, and
wherein said first signal ~~dependent on the ambient influences~~ passes through said electrical filter and is combined with driving signals for said actuator means of the apparatus to compensate said ambient influences.

63. (Currently Amended) A method for operating an imaging or raster-mode scanning apparatus for compensating ambient influences that may degrade the imaging of a sample object, the apparatus including an internal actuator or internal control element and an image processor,
comprising the steps of:
providing a driving signal and driving said actuator or control element to produce an image of the sample object,
providing a first signal dependent on the ambient influences,
supplying said first signal to a signal input of an electrical filter having a settable transfer

characteristic which can be set by applying a second signal to a calibration input of the electrical filter, and

passing the first signal directly through said electrical filter,

providing an output signal of the electrical filter,

~~providing a~~ combining said driving signal for ~~an~~ said internal control element of the apparatus ~~and combining same~~ with said output signal of said electrical filter, which has an effect on the imaging of ~~an~~ said image processor ~~of said imaging or raster-mode scanning apparatus~~, effecting the apparatus into a calibrated state, by applying said second signal to the calibration input of the electrical filter for setting the transfer characteristic, such that any image degradation from ambient influences is ~~greatly reduced or essentially~~ compensated ~~for~~ to a certain extent.

64. (Previously Presented) The method according to claim 63, wherein the calibration of the apparatus is carried out by manual setting of the electrical filter.

65. (Previously Presented) The method according to claim 63, wherein said internal control element is a member of said image processor for effecting the compensation of the image degradation.

66. (Previously Presented) The method according to claim 63, wherein said internal actuator is a means for moving an electron beam relatively to a sample object so as to form a scanner and the compensation of the image degradation is carried out at least partially by driving said internal actuator.

67. (Currently Amended) The method according to claim 63, also including:

providing a sensor which is arranged outside said imaging or raster-mode scanning apparatus and is for detecting ambient influences that degrade the imaging, and drives said first signal input of said electrical filter,

providing a predetermined reference object and a first image signal of said reference object,

wherein the apparatus is operated in a calibration mode ~~and subsequently in an image mode, whereby~~ by applying said second signal to said calibration input of said electrical filter which is produced by imaging of said reference object under ambient influences to obtain a second image signal and comparing the second image signal of the reference object with said first image of the reference object, and

~~whereby in the calibration mode, the degeneration of the image is greatly reduced or essentially compensated for~~

wherein the apparatus is subsequently operated in the image mode,

~~the degradation of the image is at least partially compensated for by maintaining the calibration, even in the event of a change in the ambient influences.~~

68. (Currently Amended) The method according to claim 67, wherein the calibration mode comprises at least the following steps:

acquiring an image of a selected section of the predetermined reference object by scanning the reference object avoiding degradations so as to produce said first image signal of the selected section;

determining the first signal which depends on any ambient influence at the location of the sensor, ~~by the sensor~~ which is arranged outside ~~the~~ said imaging or raster-mode scanning apparatus;

applying the first signal to the signal input of said electrical filter;

acquiring an image of said selected section of the predetermined reference object by scanning of the reference object under ambient influence so as to produce ~~an actual~~ said second image signal of the selected section;

comparing ~~the actual~~ said second image signal of the selected section of the reference object under ambient influences with ~~a prestored undistorted~~ said first image signal of the reference object so as to form an error signal which is a difference between ~~prestored undistorted~~ said first image signal and ~~actual~~ said second image signal;

applying ~~the~~ said second signal, derived from said error signal, to the calibration input of said electrical filter for setting the transfer characteristic of the electrical filter;

applying the output signal of the electrical filter to the signal input of a regulating amplifier;

applying the output signal of said regulating amplifier to ~~an~~ said internal actuator which is for scanning ~~a sample object or~~ said reference object by deflecting an electron or light beam by moving a ~~sample~~ holder for said reference object relative to said beam, said deflecting of said beam or said moving of said ~~sample~~ holder being influenced so as to correct imaging;

repeating the iterations of the steps of comparing said ~~actual~~ second image signal and said ~~prestored undistorted~~ first image signal so as to modify said characteristic of said electrical filter for minimizing said error signal and storing data determined by iterative calibration for providing the transfer characteristic of the electrical filter for said image mode.

69. (Currently Amended) The method according to claim ~~68~~ 67, wherein ~~in~~ the image mode comprises the following steps:

acquiring an image signal of said sample object ~~is acquired~~ by scanning, with said settable transfer characteristic of said electrical filter being fixed in said calibration mode,

~~and wherein~~ passing said output signal of said electrical filter ~~after passing~~ through a regulating amplifier, and

~~is supplied~~ supplying said amplifier output signal to ~~an~~ said internal actuator or control element.

~~which is a means for moving a beam relatively to said sample object in the manner of a scanner, with the result that the ambient influences that degrade the imaging of the sample object acquired~~

~~by the scan are greatly reduced or essentially compensated for~~

70. (Previously Presented) The method according to claim 63, wherein said image processor makes an image analysis of an image of a sample object or a reference object acquired by said imaging or raster-mode scanning apparatus and produces a setting signal dependent on such image analysis which is applied as said second signal to said calibration input of said electrical filter.

71. (Previously Presented) The method according to claim 70, wherein the image analysis comprises a recursive determination of a temporal displacement of line centroids of successive image lines within the image of said reference object, and
whereby said second signal is calculated from said temporal displacement.

72. (Previously Presented) The method according to claim 70, wherein successively images of said reference object are taken, wherein the image analysis comprises a recursive determination of a temporal displacement of image centroids of said successive image, and
wherein said second signal is calculated from said temporal displacement.

73. (Previously Presented) The method according to claim 71, wherein essentially a cross-correlation of the first signal with the second signal is carried out and an output signal of the electrical filter which is dependent on the cross-correlation between the first signal and the second signal is supplied to said actuator or control element.

74. (Previously Presented) The method according to claim 63, comprising the steps of
feeding said image processor with an image signal from an image acquirer;
applying a signal dependent on the result of said analyzing step as said first signal to said signal input of the electrical filter;
applying a signal dependent on the result of the analyzing step as the second signal to said calibration input of the electrical filter; and
applying the output of the electrical filter via a regulating amplifier to said internal actuator or said internal control element so as to reduce imaging degradation.

75. (Currently Amended) The method according to claim 74, wherein , in successive time periods, successive images of said sample object or of a reference object are produced, successive image lines within any successive image ~~acquired~~ and line centroids thereof or image centroids of successive images are determined, and wherein said analyzing step comprises a recursive determination of any displacement of said line centroids of said successive image lines within the image or a recursive determination of any displacement of said image centroids of successive

images.

76. (Previously Presented) The method according to claim 63, wherein control elements acting in two mutually orthogonal directions are provided for compensating any image degradation.

77. (Currently Amended) An apparatus for compensating for ambient influences in imaging or raster-mode scanning apparatuses that may degrade the imaging with an image acquisition and an image processing device producing an image of a sample object or a reference object, comprising
a calibratable digital electrical filter with a signal input and a calibration input;
a regulating amplifier which is electrically connected downstream of the electrical filter,
an internal control element controlled by the regulating amplifier;
wherein a first signal dependent on the ambient influences is applied to the signal input of the electrical filter which generates an output signal at the output of the electrical filter, and
wherein a second signal is applied to the calibration input of the electrical filter to calibrate the electrical filter, and
wherein the internal control element has an effect on said image produced by said image acquisition and image processing device,
whereby in the calibrated state of the electrical filter, the image degradation is ~~greatly reduced or essentially~~ compensated ~~for~~ to a certain extent.

78. (Currently Amended) The apparatus according to claim 77, further comprising at least one sensor for detecting at least one physical quantity outside the imaging or raster-mode scanning apparatus, this sensor outputting the first signal which is dependent on the ambient influences at the location of the sensor.

79. (Currently Amended) The apparatus according to claim 49, wherein the apparatus is designed for operation in a calibration mode and for subsequent operation in an image mode, whereby, in the calibration mode
a first image signal of said reference object is provided, and under ambient influences, a second image signal of said reference object is provided, then the first image signal and the second image signal are compared in the image processor, ~~ambient influences which degrade the image are detected by the comparison of the image of the predetermined said reference object under ambient influences with prestored undistorted image signal of the reference object in the image processors~~
wherein the comparison results in a difference representing an error signal being assigned to the second signal for setting the transfer characteristic of said electrical filter, whereby by calibration of the electrical filter ambient influences which degrade the image signals are ~~greatly reduced or~~

~~essentially~~ compensated ~~for~~ to a certain extent.

80. (Previously Presented) The apparatus according to claim 49, wherein the apparatus is set up for automatically calibrating the electrical filter.

81. (Previously Presented) The apparatus according to claim 49, in the form of a light microscope or a transmission electron microscope also comprising means for analyzing temporal displacement in said image signals, the first signal also being determined from said temporal displacement in said image signals.

82. (Previously Presented) The apparatus according to claim 56, in the form of a light microscope or a transmission electron microscope also comprising means for analyzing temporal displacement in said image signals, the first signal also being determined from the temporal displacement that is determined in said image signals.

83. (Currently Amended) The apparatus according to claim 46, for operation in a calibration mode and subsequently operable in an image mode, whereby, in the calibration mode, a first image signal of said reference object is provided, and under ambient influences, a second image signal of said reference object is provided, then the first image signal and the second image signal are compared in the image processor,

~~ambient influences which degrade the image are detected by the comparison of the image of said optional reference object under ambient influences with a prestored undistorted image signal of the reference object in the image processor~~

wherein the comparison results in a difference representing an error signal being assigned to the second signal for setting the transfer characteristic of said electrical filter as to reduce ambient influences which might degrade imaging.